The Mining Journal
AND COMMERCIAL GAZETTE.

SUPPLEMENT.

PROCEEDINGS OF SCIENTIFIC MEETINGS.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

[*Continued from page 6.*]

SECTION B.—CHEMISTRY AND MINERALOGY.

One of the first communications to this Section was an account of a new species of Blowpipe, invented by Mr. Ettrick.

The principal novelty in this apparatus was the method employed for maintaining a constant blast independent of hydrostatic pressure. This was accomplished by small bellows, thrown into very rapid action by means of a wheel and pinion, and a stop-cock inserted in the tube connecting the bellows and cylindric reservoir. To prevent the air from being too much compressed, the bellows were furnished with a valve, opening outwards, and which was pressed upon by a spring, the force of which admitted of being very readily varied. From the cylinder there are two eduction pipes, terminated by nozzles, so that by using these, and a pair of lamps, two jets of flame might be brought to bear upon the same object. He also explained how air might be made to issue from one, and coal, or other inflammable gas, from the other; and exhibited a tube similar to that long since described by Professor Daniell, by the use of which a combustible atmosphere might be made to issue from an orifice without any previous mixture in a reservoir.

Dr. Hare, of Philadelphia, described to the Section a method of Blasting Rocks, which he had invented, and which has hitherto only been used in America. The apparatus, it appears, consists

Of two copper wires, joined by a small platina wire, in the middle of a tin case containing the gunpowder to be exploded. The two extremities are attached to a calorimeter, and when this is set in action the voltaic ignition is effected. The advantages of this mode are, that the action is instantaneous, and may be carried to a considerable distance from the persons employed. Dr. H. stated that twelve simultaneous discharges in a rock had been made at 150 feet distance; and he had no doubt that very large blocks for columns, &c., might thus readily be detached. These combined explosions may, of course, be made beneath water, and afford an obvious mode of blowing up rocks impeding navigation.

Besides these advantages, the causes of human suffering and calamity are lessened. If the explosion is not effected the instant the voltaic apparatus is in full use, then the cause of failure may fearlessly be sought after the voltaic apparatus has been disconnected, and thus the many accidents resulting from approaching and disturbing a delayed but ignited train are avoided.

Instances were given of this description, and a painful case related, where the ignited train had not exploded; and after two hours had elapsed, the unfortunate man descended into the mine, which was filled with suffocating gases, evolved from the smouldering combustion of the train and some tallow, &c., accidentally present; he was followed, at different intervals, by his two sons, who also fell victims. By Dr. Hare's method of firing the gunpowder, these and other obvious dangers are avoided.

A paper was read "on the Reduction of Chemistry to Mathematical Principles," by Mr. Exley. The importance, as well as extreme difficulty, of the object in view, must be obvious to all who are acquainted with chemical science. Without attempting to follow the profound and elaborate investigations which Mr. Exley has gone into, it is sufficient to observe that they met with approbation from several distinguished chemists who were present, especially the venerable Dr. Dalton, whose researches have thrown so much light on the numerical relations of chemical combinations, that he may almost be considered the founder of this department of science.

A paper was read by Dr. Daubeny, on the subject of "Mineral Waters," a branch of research to which he is well known to have given much attention. In this paper he investigated, at great length, the source of the high temperature of many mineral waters, and also of the various substances held in combination.

A communication of some importance, as regards the manufacture of iron, was made by Mr. Mushet. This gentleman exhibited to the Section several specimens of malleable iron, which he had made by a new and peculiar process, and explained at some length certain views of his own, with reference to the ordinary process of smelting iron.

The iron, when first reduced in the upper part of the furnace, is in the malleable state, but, in its progress downward, it is, in virtue of exposure to a higher temperature, and the redundancy of charcoal it encounters, converted first into steel, and finally into pig-metal. His own process consists in submitting the ore to the actions alone which it experiences in the upper part of the furnace—that is, in restraining the heat, and furnishing but a limited supply of carbon; and operating by such method, and without the use of lime, he stated that he was able to obtain at once, and by a single process, iron soft enough to admit of being forged into nails. Mr. Mushet also described a new variety of water cement, differing from those ordinarily manufactured, in the circumstance of the iron being present in the metallic form.

Dr. Dalton explained to the Section his views relative to "Chemical Notation," endeavouring to prove the superiority of his own plan of symbolic expressions over that introduced by Berzelius and other chemists. This communication, and the discussion which followed, are, however, only interesting to those deeply versed in chemistry.

A short statement was made by Mr. Hodgkinson relative to his experiments on the "Hot and Cold Blast," as applied in the iron manufacture. From this statement it appears that he found No. 1 and No. 2 iron possess *less* tenacity when made by the *hot* than by the *cold* blast. A singular anomaly, however, presents itself in the Devon iron, No. 3, in which exactly the reverse takes place. This iron, when made by the *hot* blast, was found to be *softer*, but at the same time *much stronger*, than when made by the *cold* blast. Mr. Hodgkinson's experiments will be continued at the request of the Association, and much benefit may be expected to result from them, bearing directly, as they do, on the greatest recent improvement of one of our most important national manufactures.

Mr. Cross communicated to the meeting an account of his experiments on electricity and magnetism, and the artificial production of various crystalline substances, hitherto only known to occur in the mineral kingdom. The latter subject was also laid before the Geological Section, as more immediately bearing on that science, and will therefore be found in our report of its proceedings.

His experiments upon the electricity of the sky were performed on the grandest scale, and with effects proportionally striking and brilliant, in consequence of his conductor being a wire of prodigious length, and being insulated, and other wires arranged in a very skilful manner. The results, however, at which he arrived, concur with those of other philosophers. For clear and steady weather the air is always positive, but in cloudy and foggy weather is perpetually varying from positive to negative; sometimes also appearing to be in the neutral state. These phenomena, which would appear easily deducible from the principle of induction, as applied to the action of a cloud at different distances from the conductor, the intervening stratum of air varying in the degree of its conducting power, Mr. Cross explains by supposing an electrified cloud as an aggregate of discontinuous masses of vapour, or that it is composed of a succession of zones not in contact, and maintained by the inductive influence they exercise upon each other in oppositely excited states. Such also is, he finds, the case of fogs; and he stated that upon one occasion he distinctly found a mist which was drifted across his apparatus, to be composed of, as he expressed it, a succession of marching columns in opposite electrical states. Upon the effects which he proceed by operating with the electricity of the atmosphere, it is not necessary to dwell. By its means he ignited combustible bodies, tore in pieces the most rigid materials, resolved chemical compounds into their elements, magnetized, and, in a word, reproduced, though upon a much more gigantic scale, all the known agencies of the artificial forms of the electric influence. Mr. Cross's observations upon the pile need not detain us long. The improvements he suggests, that the plates of the same couple should be brought as close as possible to each other, and immersed in glass jars, so that the different pairs should be, as much as possible, in a state of insulation, have been suggested by others—the former by Drs. Hare and Faraday, and the latter by Professor Hare, who employed cylindric glass vessels in his celebrated calorimeter. This latter contrivance, indeed, is very old; for it was employed by Volta in his *Couronne des Tasses*, one of the very first modifications of his extraordinary instrument constructed by him. The views put forward by Mr. Cross, in reference to the origin of galvanic electricity, do not agree with those at present generally entertained. He abandons what is called the chemical theory, and reverts to the views originally propounded by Volta; namely, that the electricity is the result of the contact of the metals, and the acid merely acts as a conductor. It appears that Mr. Cross never found his electrometer affected by the aurora borealis, sheet lightning, halos, or other luminous atmospheric phenomena.

Some fine octahedral crystals of iron pyrites were exhibited by Mr. Law, which had been artificially formed in the manufacture of sal-ammoniac.

SECTION C.—GEOLOGY AND GEOGRAPHY.

The communications made to this Section relate principally to geology, and no better evidence of the rapid march of this science can be adduced than from their number and importance.

The first paper communicated to the meeting was by Mr. Charlesworth, and is of considerable interest with reference to tertiary geology; a subject to which he has very successfully devoted his attention.

Mr. Charlesworth's paper is entitled "a Notice of the Vertebrated Animals found in the Crag of Norfolk and Suffolk."

The author first adverts to the probability of the tertiary deposits above the London clay, in the eastern counties of England, not belonging, as has been generally supposed, to one formation. He then proceeds to establish the fact of the remains of mammiferous animals being indiscriminately associated with marine testacea in a fossiliferous stratum, which appears to extend from Cromer, in Norfolk, to within a few miles of Aldborough, in Suffolk. The author has not detected any traces of mammalia in the coralline crag, or in that portion of the upper deposit which skirts the southern coast of Essex and Suffolk. The bones of land animals found in the crag have undergone the same peculiar chemical changes as that exhibited by the teeth of fish, and which readily distinguishes them from those belonging to the overlying diluvial strata.

Teeth of the *mastodon angustidens* have recently been found at Thorp and Bramerton (near Norwich), parishes adjoining Witlingham, the spot in which the specimen figured by Dr. William Smith was said to have been obtained. The mastodon appears to be the only mammiferous animal which became extinct during the crag epoch; all the others at present discovered in that formation being either identical with existing species, or with those found in the more recent diluvial and lacustrine deposits.

The author next proceeds to notice the remains of birds, which he has recently procured from several localities in the crag district. These occur in a highly mineralized state, and consist principally of bones belonging to the extremities of natatorial tribes.

The class of vertebrated animals whose remains are met with in the most abundance is that of fish. These, however, differ widely in their geological and geographical distribution. Such as are found in the stratum which contains mammalia, consist principally of the hollow tubercles of various species of rays, with prodigious numbers of very singular bones, which have externally very much the character of coprolites; but which are thought by Agassiz to belong to the genus platax, a tropical fish. These bones are not met with in the crag of Essex and the southern part of Suffolk; but throughout that part of the formation, the teeth of several genera of the shark tribe occur in considerable abundance. Of these, the most remarkable is the *carcharias megalodon*, specimens of which are found as large as those from the tertiary beds of Malta.

No remains of reptiles have yet been discovered in the crag, which would rather support the opinion advanced by Dr. Beck and M. Deshayes, that during the period of its formation the climate resembled that of the arctic regions.

A second paper by Mr. Charlesworth, "on some Fallacies involved in the Results (relating to the comparative age of tertiary deposits) obtained from the Application of the Test recently introduced by Mr. Lyell and M. Deshayes," was not read till the Friday, but we prefer placing this paper together with the former, so as to exhibit more clearly the results of this gentleman's researches in English tertiary geology. The paper before us is of great importance, as it tends to show that Mr. Lyell's views are in practice complicated by a variety of circumstances, to which no attention has hitherto been paid; and which have the effect of materially invalidating the conclusions usually deduced from them. We now proceed with Mr. Charlesworth's communication.

During the author's investigation of the fossiliferous strata above the London clay in Suffolk and Norfolk, some facts have come under his observation, which appear to him to point out sources of error to a considerable extent in the application of the test recently proposed by M. Deshayes and Mr. Lyell, and which is now so generally made use of in the classification of tertiary formations.

The crag has been referred by Mr. Lyell to his older *pliocene* period, on the authority of Deshayes, who identified among the fossil testacea of that deposit forty per cent. with existing species. The correctness of this result has been called in question by other eminent conchologists, particularly by Dr. Beck, of Copenhagen, who has examined the crag fossils in the author's collection, and considers that the whole of them are extinct. In this opinion Dr. Beck is supported by Mr. G. B. Sowerby, who states that he has only met with two or three crag shells, which may, perhaps, be identified with existing species. Professor Agassis has inspected an extensive series of ichthyological remains, collected from the crag by the author, and pronounces them all to belong to extinct genera or species; while a precisely similar result has attended Dr. Milne Edwards's examination of the corals.

Professor Phillips, in his Introduction to Geology, has placed the crag in the *miocene* division; while Dr. Fleming, who for more than a quarter of a century has been an indefatigable collector of British shells, considers that the proportion of recent species in the fossils of that formation has been rather *under* than over rated by Deshayes; and among the corals of the crag he has detected a large proportion of living forms.

The particular one of Mr. Lyell's divisions to which a geologist will refer any given deposit must, therefore, depend upon his own estimate of the characters which constitute specific distinctions, and which is evidently liable to the greatest possible amount of variation.

The author next enters upon an inquiry respecting the course which should be adopted in retaining the relations of analogy presented by the fossils of different deposits to one another, or to the races in existence at the present period. The effect of the method now made use of is to class as contemporaneous, those deposits which respectively furnish the same per-centage of extinct forms, without the slightest reference to the greater or less degrees of approximation which these forms exhibit when compared with living types. The conchologists who agree with Dr. Beck cannot, by means of the per-centage test, express the difference in the amount of approximation presented by the testacea of the crag and London clay to those now existing, because they would consider all the fossils of both these formations extinct, and, consequently refer them both to the *eocene* division.

In this instance, the relations of analogy can only be obtained by a general estimate of the amount of resemblance borne to existing species by the entire series of crag or London clay fossils, taken collectively. This mode of procedure may, at first, appear only a different adaptation of the numerical plan adopted by Mr. Lyell. It will, however, be found an important modification of his principle; for, when applied to the fossils of those formations which, from the presence of living species, can also be subjected to the per-centage test, it will, under some circumstances, furnish results that clearly establish a fallacy in one of the two methods. For instance, the red and coralline crag are supposed by Deshayes to contain the same number of extinct species; and, by the per-centage test, they, therefore, present an equal approximation to the existing organization. But if the shells, which Deshayes thinks he can identify with those now inhabiting the German Ocean, are rejected, and the ext nct testacea alone compared with the living types, the forms most remote from existing species will be found to occur in that series which has been derived from the coralline crag.

The author then changes his line of argument, and, assuming that there is a general agreement among conchologists as to the characters which should be depended upon in discriminating species, and also that the per-centage test is the true method of obtaining relations of analogy, he proceeds to inquire whether the association of organic remains in fossiliferous deposits implies their previous contemporaneous existence. The evidence drawn from this source appears to the author to be by no means so conclusive as it has been generally considered; and his opinions have been formed principally from an attention to the causes now in operation upon the earth's surface.

Mr. Charlesworth then points out that estuaries, intersecting the crag formation, have in some places effected a complete denudation of this deposit. Thus, by causes now in operation, the fossils of the crag are swept in vast numbers into the German Ocean, and there intermingled with existing species of mollusca. In another spot, the mammalian remains of the crag are removed in a similar manner, and in great abundance. Thus, it is evident, that a deposit is now accumulating in the bed of the German Ocean, in which the organic remains of the coralline crag, of vertebral animals occurring in the upper part of that deposit, and of existing testacea, and perhaps occasionally existing mammalia, are all indiscriminately mingled together. Mr. Charlesworth then supposes that, in the lapse of ages, the recession of the sea, or the elevation of the land, may expose to the view of the geologist the deposit in question. He shows, that in this case the remains would be considered as contemporaneous, and the most erroneous conclusions drawn from them. The idea that the fossils washed from the crag would become worn, and thereby distinguishable from recent species, is successfully combated, by reference to the perfect state of these fossils when disimbedded from the matrix, and washed again on the shore by the sea.

Mr. Charlesworth adverts to the singular fact of the bed of the ocean adjoining our eastern coast being strewed with vast accumulations of extinct mammalia; in some cases to the distance of twenty miles from the shore; and notices that the fishermen, in dredging for oysters, had often been put to inconvenience from the number of elephants' bones and teeth, which had become entangled in their nets. Hence it is plain that at the present time these ancient remains are becoming imbedded in recent stratified deposits, and intermingled with the reliquia of the present inhabitants of the ocean. It is plain, therefore, that very erroneous conclusions may have been drawn from similar associations in stratified deposits on our northern coast and elsewhere.

During the formation of this deposit, causes similar to those now in existence appear to have been in operation; and effects have there been produced which exactly correspond with the author's deductions as to the nature of the formations at this time in progress round some parts of the British coast.

This introduction of secondary shells in the tertiary beds of Norfolk and Suffolk has been detected solely by an attention to lithological characters; and the evidence derived from this source is no longer available when there is reason to suspect an admixture of organic remains belonging *exclusively* to rocks of the supra-cretaceous series.

The species which are *common* to the chalk and red crag are very few when compared with those which are common to the *red crag* and to the subjacent *tertiary* strata. In the latter case, however, we have no means of ascertaining whether those individual species which occur in separate formations existed throughout distinct periods, or, like the fossils of the chalk, were, by the natural process of degradation, removed from their original matrix, to be again entombed with the races of a more recent epoch. Unless this difficult problem is solved, it is clear that the application of the per-centage test may be attended with the most fallacious results. To what extent erroneous conclusions may already have been formed, from the neglect of those considerations so obviously necessary in the examination of the crag, must be a subject for future investigation.

The author lastly notices some questions which have already been discussed by Professor Phillips in the *Encyclopædia Metropolitana*. The most important of these is the physical relation existing between any one fossiliferous deposit, and the locality in which the living types of its fossil species occur.

The Marquis of Northampton fully agreed with Mr. Charlesworth as to the erroneous conclusions which future geologists would form respecting the relative ages of tertiary strata, from their not being able to distinguish between the living species of testacea, now becoming fossilised, and the older shells which are imbedded with them. He had observed, in the island of Sicily, an admixture of fossil and recent species taking place, very similar to that mentioned by Mr. Charlesworth; and the fishermen had brought him hermit crabs, which he found were *actually inhabiting fossil shells*. If these, at some future period, should be found by geologists, they would, of course, conclude that the crab and its habitation were contemporaneous.

Dr. Buckland, after dilating at considerable length upon the important results attending Mr. Charlesworth's investigation of the crag, entered upon the consideration of Mr. Lyell's divisions of tertiary formations. He was quite willing to acknowledge the imperfection of Mr. Lyell's systematic arrangement; but, bad as it was, it was the best at present proposed, and he had, therefore, adopted it in his *Bridgewater Treatise*.

Professor Sedgwick mentioned the names of Mr. Samuel Woodward and Mr. R. C. Taylor, both of whom, as well as Mr. Charlesworth, have contributed considerably towards elucidating the history of the crag formation. He certainly did not agree with many of Mr. Lyell's general views upon geological subjects, but he thought Mr. Lyell has proceeded upon right principles in his classification of tertiary formations.

Some remarks then fell from Mr. Murchison, with reference to a gentleman (the Rev. W. B. Clarke) who had formerly resided in Suffolk, and had taken great interest in the geology of that county. Mr. Clarke was then present, and he hoped he would favour the Section with some observations.

Mr. Clarke then rose, and, in the course of his remarks, observed that Mr. Charlesworth might have pointed out a much greater error of Mr. Lyell's than any brought forward in his (Mr. C.'s) paper. He alluded to the bed of diluvial clay overlying the crag, and which Mr. Lyell had confounded with the crag formation.

Mr. Charlesworth stated that the fact mentioned by Mr. Clarke was totally foreign to the subject under discussion. The object of his paper was not to point out any errors which Mr. Lyell might have committed with respect to the geology of Norfolk and Suffolk, but to show that fallacious results would arise from the general adoption of Mr. Lyell's principles in the classification of tertiary deposits.

An account of some bone caverns at Cefn, in Denbighshire, by Mr. Bowman, was afterwards given, from which it appeared that

The caves are in carboniferous limestone. The roof of the lower cave is covered with stalactites, which are often broken off or blunted. The diluvium on the floor contains fragments of slate, and the upper portion includes animal remains in great abundance. Among these are some of a very minute size, and also elytra of beetles. A black matter is also found, with veins of reddish clay. The bones are often in fragments, the teeth are something worn; sometimes the teeth of young animals, but no indentations have been found upon them. No skulls have been discovered, nor any coprolites. The bones frequently contain gelatine, and have often manganese upon them; hair was also discovered. The stalactites seem confined to the anterior part of the cave; in the posterior part a fine sand is found.

Mr. Greenough mentioned a new mode of engraving medals lately adopted in France, and which he conceived could be advantageously employed in laying down the varieties of surface on maps.

Mr. Griffiths spoke of the great importance of models, like Mr. Ibbotson's, as being so well calculated to display the geological structure of a country. He suggested the importance of possessing maps, both of outline and of features; and he alluded to the magnificent map of Ireland, under the Ordnance Survey, the scale of which, being six inches to a mile, enabled the geological observer to trace the geological features with a facility before unknown. It was mentioned, that the new map of Austria was on a scale of twenty-two inches to the mile, but this Mr. Greenough considered inconveniently large.

Mr. Ibbotson stated that models could be easily multiplied by employing a metal mould, and using *papier maché*, or some preparation of caoutchouc; and that they might be dissected to exhibit the internal structure, and that the materials of the strata themselves could be used as colouring matter.

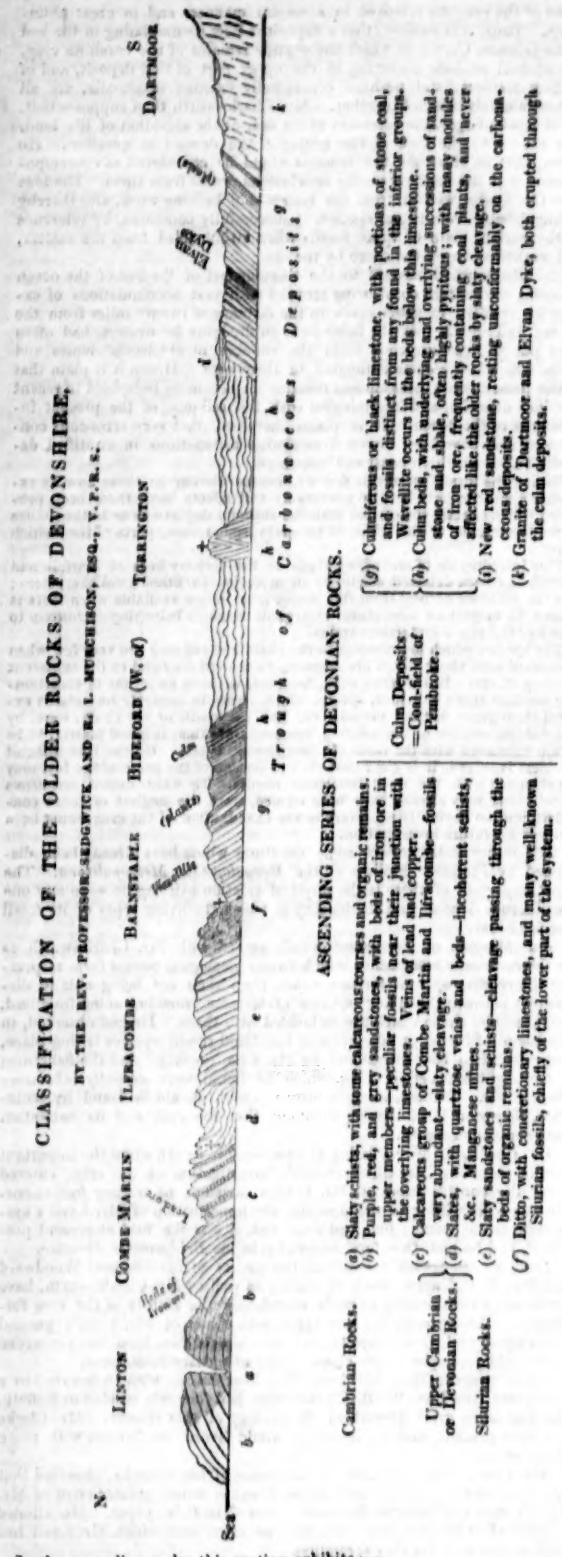
Lord Northampton and Mr. de la Beche gave their testimony of approval.

Several gentlemen then spoke of the application of combinations of letters to geological maps, to express the more minute geological phenomena; but the general opinion was, that in geological maps simplicity should, as much as possible, be preserved; and that the best mode would be to have two maps of the same district, one without names, for the geological map, and the other with the necessary writing. Maps of this kind had been given to the Geological Society by the Archduke John of Austria.

The proceedings of Tuesday were of a very interesting nature, and we avail ourselves of the following excellent report of them given by the *Athenæum*.

The first paper was "A Classification of the Old Slate Rocks of Devonshire, and on the true position of the Culm Deposits of the central portion of that county," by Professor Sedgwick and Mr. Murchison.

The authors began by observing, that this was a mere outline of a more detailed memoir on the physical structure of Devonshire, which they were about to lay before the Geological Society of London. In the published geological maps of that county, the whole system of the older slate rocks was represented under one colour, without any attempt at subdivision; and one colour also represented different limestones, without any discrimination. The object of the authors was, to remedy these defects,—to ascertain and represent the true position of the successive deposits and their natural subdivisions, so as to compare them with corresponding deposits in other places. They also wished to determine the true place of the remarkable carbonaceous deposits of central Devon, which had been previously regarded as belonging to the lowest portion of the grauwacke formation. A section was exhibited of part of that county, from the north coast to one of the granite peaks of Dartmoor, immediately south-west of Oakhampton.


CLASSIFICATION OF THE OLDER ROCKS OF DEVONSHIRE,
BY THE REV. PROFESSOR SEDGWICK AND R. I. MURCHISON, ESQ., V.P.R.S.
N
Barnstaple
Ilfracombe
Torrington
S
Dartmoor
Liston
Combe Martin
Ilfracombe
Sea
Trough of Carboniferous Deposits
Elvan Dyke
Lode
Lode of Iron ore
Cambrian Rocks.
Upper Cambrian or Devonian Rocks.
Silurian Rocks.
Culm Deposits = Coal-field of Pembroke.
ASCENDING SERIES OF DEVONIAN ROCKS.
(a) Slaty schists, with some calcareous courses and organic remains.
(b) Purple, red, and grey sandstones, with beds of iron ore in upper members—peculiar fossils near the junction with the overlying limestones. Veins of lead and copper.
(c) Calcareous group of Combe Martin and Ilfracombe—fossils very abundant—slaty cleavage.
(d) Slates, with quartzose veins and beds—incoherent schists, &c. Manganese mines.
(e) Slaty sandstones and schists—cleavage passing through the beds of organic remains.
(f) Ditto, with concretionary limestones, and many well-known Silurian fossils, chiefly of the lower part of the system.
(g) Culmiferous or black limestone, with portions of stone coal, and fossils distinct from any found in the inferior groups.
(h) Culm beds, with underlying and overlying successions of sandstone and shale, often highly pyritous; with many nodules of iron ore, frequently containing coal plants, and never affected like the older rocks by slaty cleavage.
(i) New red sandstone, resting unconformably on the carboniferous deposits.
(k) Granite of Dartmoor and Elvan Dyke, both erupted through the culm deposits.

In the ascending order this section exhibits:—

1. A system of slaty rocks, containing a vast abundance of organic remains, generally in the form of casts. These rocks sometimes pass into a fine glossy clay slate, with a true transverse cleavage; sometimes into a hard quartzose flagstone, not unusually of a reddish tinge; sometimes into a reddish sandstone, subordinate to which are beds of incoherent shale. In North Devon they are very rarely so calcareous as to be burnt for lime, but in South Devon, rocks of the same age appear to be much more calcareous.

2. A series of rocks characterized by masses of hard thick-bedded red sandstone, and red micaceous flagstone, subordinate to which are bands of red, purple, and variegated shales. The red colour occasionally disappears, and the formation puts on the ordinary appearance of a coarse, silicious grauwacke, subordinate to which are some bands of imperfect roofing slate. In this series are very few organic remains. It is of considerable thickness, occupying the whole coast, from the west end of the Valley of Rocks to Combe Martin.

3. The calcareous slates of Combe Martin and Ilfracombe, of very great aggregate thickness, abounding in organic remains, and containing in a part of their range at least nine distinct ribs of limestone burnt for use. This limestone is prolonged into Somersetshire, and appears to be the equivalent of that on the flanks of the Quantock Hills.

4. A formation of greenish and lead-coloured roofing slate of great thickness, and occupying a well-defined zone in North Devon, its upper bed alternating with and gradually passing into a great deposit of sandstones of various colours, and micaceous flagstones. These silicious masses alternate with incoherent slates, and are in some places surmounted by great masses of red unctuous shale, which, when in a more solid form, generally exhibit cleavage oblique to the stratification.

5. The Silurian system resting conformably on the preceding, and of great thickness, on the north-western coast, containing many subordinate beds and masses of limestone. In its range towards the eastern part of the county it gradually thins off, but its characters are well preserved, and it every where contains vast numbers of characteristic organic remains.

6. The carbonaceous system of Devonshire, in a direction east and west across the county, in its southern boundary so close to Dartmoor that its lower beds have been tilted up and altered by the granite. It occupies a trough, the northern border of which rests, partly in a conformable position upon the Silurian system, and partly upon older rocks, probably of the division No. 4. Its southern border also rests on the slate rocks of Launceston. It every where exhibits a succession of violent contortions. In some places it is overlaid by patches of green sand, and west of Bideford by conglomerates of the new red sandstone. The lowest portion of this vast deposit is generally thin bedded, sometimes composed of sandstone and shale, with impressions of plants, sometimes of indurated compact slate, containing wavellite. These beds are surmounted by alternations of shale and dark-coloured limestone, with a few fossils. Subordinate to these, there are on the western side of the county thin veins and flakes of culm or anthracite; but this is wanting on the eastern side, and the calcareous beds are more expanded. The higher beds of this deposit are well exhibited on the coast west of Bideford. These often contain impressions of vegetables. Though in a state of greater induration than the ordinary coal-measures of England, and even in many places destitute of any trace of coal, still these beds do not differ from the great unproductive coal-field of Pembrokeshire. They consequently concluded, that from the order of superposition,—from mineral structure—from absence of slaty cleavage, peculiar to the older rocks on which this deposit rests, and from the specific character of its organic remains, it may, without hesitation, be referred to the regular carboniferous series.

In the course of the details, the authors alluded to a remarkable elevated beach, occupying two miles of coast on the north side of Barnstaple Bay, a more special account of which is being prepared for the Geological Society.

Mr. De la Beche objected to the conclusions of Messrs. Sedgwick and Murchison, although he did not dispute the correctness of the section of the country which they had exhibited to the meeting. He conceived that he had traced the carbonaceous rocks passing into what had been termed the Cambrian system, although he was not prepared to say that it really was that system. He was also unable to make that separation of the contorted rocks suggested by the authors of the paper. He spoke of the overlying greenstones in different places, and considered that these were of different ages; also of the changes produced by granite on rocks of every kind in contact with it. He alluded to the former opinions of the rocks called by the general name, greywacke, which opinions have, of late years, been totally altered. He attaches very little importance to mineral characters; unless the consideration of the imbedded organic remains was made of the first importance, we were sure of failing into error. Are the organic remains in these carbonaceous rocks of Devon really the same as those of the general carboniferous system? He stated that he conceived there was evidence to prove that there was a regular band of rocks surrounding Dartmoor, which had been thrust up through the hollow in the middle. He could no where discover any line of separation between the carbonaceous and the older rocks, so that he was unable to reconcile the deposits of coal with those of other parts of England, and with the age of these older rocks all were agreed. In the Alps, organic remains of the coal formation are found in beds, alternating with oolites, so that we must not limit too strictly the range of these organic remains, as we should be certain of all the conditions under which coal plants can be accumulated. We should recollect, that the remains of the vegetation of a mountain may be entombed at its base, so as to be shifted from its original habitat; and that, although the disposition of organic remains may hold true for a certain extent of the earth's surface, we have no right to consider such a disposition universal.—Mr. Sedgwick remarked, that he could with certainty distinguish four calcareous strata in North Devon—viz. one at Linton, a second at Ilfracombe, and two others at Barnstaple. The difference of the limestones of South Devon was also very remarkable; that of Plymouth being essentially distinct from that of Dartmoor. These carbonaceous strata also extended several miles into Cornwall.—Mr. Conybeare considered that the public had exaggerated the difference of opinion then before the meeting. He was rather inclined to coincide with Messrs. Sedgwick and Murchison in considering the strata in dispute as referable to the general carboniferous system; and from the general resemblance of the formations of those of Pembrokeshire, the probability was much strengthened.—Professor Phillips conceived that it had been satisfactorily proved, that there existed a coal basin in the interior of Devonshire, although, at first sight, from the unprofitable nature of the contained coal, being the kind called culm, some hesitation might have taken place as to assigning it its true position. But doubts must vanish on inspecting the organic remains: and here he might observe, that it was a mistake to suppose that Dr. Smith, the founder of English geology, had ever intended to limit the range of these remains, as some had accused him of. We might readily assume, and observation has confirmed, that some organic remains of one stratum may be found in contiguous strata, associated with fossils of different kinds, so that organic remains alone are insufficient to point out dis inctions in strata. But the general appearance of the limestones of Devon was precisely similar to those of the north of England, in regard both to mineral character and imbedded ossils. From their appearance, he had expected their interstratification with shales, and Mr. Murchison had confirmed this supposition. The Devon limestone corresponded indeed with the upper bed of the Yorkshire limestone; in the former he had detected a shell, a species of *Anodon*, which he had not observed in the latter: but the species of *Posidonia* found in both exactly correspond. Perhaps one cause of mistake might have been the little attention paid to the black limestone of Craven, by Mr. Conybeare, and to this limestone there was a most striking resemblance in the black variety of Devonshire. He alluded to the extraordinary anomaly of coal plants having been found in the Alps, associated with oolites, but this might be an exception from the general law, and exceptions there must be; still it must be allowed, that organic life must have a constant relation to the state of the actual surface. He came to the conclusion, that the Devon district would not offer any anomaly in geological arrangement, but that it would correspond in arrangement with the other parts of the country, and that a fruitful source of error is the hitherto vague term greywacke, which has been applied indiscriminately to a great variety of rocks, so as to include many of different ages throughout this country.—Dr. Buckland congratulated the meeting on the difference of opinion among the geologists present, such a difference producing discussion, which was the sure means of arriving at truth. He considered, that the true solution of the question at issue would be in the middle course: that, no doubt, it could not be easily granted, that the series under consideration was *carboniferous*, when no true coal was contained in it; but, were we to adopt the new term, *culmiferous*, we should get rid of the difficulty. This culmiferous series he regarded as the lowest portion of the coal formation, and as resting upon the Silurian rocks. He alluded to the difficulty of making geological maps; these must be constantly modified, according to the extent of investigation: errors of omission must be committed by every pioneer in geology, which can only be corrected by the researches of succeeding observers.

After the discussion was closed, Mr. De la Beche rose to submit some considerations on the connexion of the geological phenomena of Cornwall and Devon with the mineral veins of those counties. He commenced with defining the local Cornish terms of *lode*, *cross course*, *counter*, and *elvan*, the first three referring to veins of metallic, the latter to a vein of granitic matter. A number of these had been laid down in his geological map of Cornwall with the most perfect mathematical accuracy. He next mentioned the overlying masses of greenstone, which are of different ages, and in some are imbedded portions of the slate rocks. Granite must have been protruded last of all the rocks, as it cuts off the greenstone in many places; but the phenomena of the veins are still more singular, as first the elvans, and then the lodes, cut through every thing. He referred to certain faults in the greensand district of Blackdown, and, most singular to relate, these faults exactly corresponded in direction with those of Cornwall, although the latter were highly metalliferous veins, while the former were fissures destitute of any valuable content. He therefore laid out the conditions of a profitable metalliferous vein, as deduced from the experience of practical miners, that it should be near the granite, and that the best signs were an elvan and a cross course. In the parish of St. Just these phenomena are in the highest degree remarkable; and, near Penzance, where the elvan courses are traversed, metals are sure to occur. The lodes of slate rocks are generally unproductive. Mr. De la Beche was particularly anxious to impress these facts on the public in general, as mining speculations had been of late so much the rage, that the more theoretical knowledge that could be diffused the better, so as to cause inquiry to be made respecting the geology of the mining district about to be entered upon by a joint stock company, before capital was invested in a hazardous, and perhaps ruinous, enterprise.

Mr. Hopkins was called upon to make some observations regarding the direction of the fissures mentioned by Mr. De la Beche, but he did not enter very fully into any discussion, as he proposed, on the following day, to bring the general consideration of fissures before the Section. He observed, however, that there must have been one great axis of disturbance, to which the smaller fissures must either have been parallel, or have circulated around it—indeed, Mr. De la Beche had supposed the great line of fissures from Blackdown to Cornwall had been curved by the intervening granites. He stated, that there must be a connexion between the width of lodes and their mineral contents—also, that in the production of fissures there must have been several periods of elevation.

Mr. Fox then mentioned a remarkable experiment which he had made upon the yellow sulphuret of copper, having changed it by electricity into the grey sulphuret. In a trough a mass of clay was placed, so as to divide it into two portions, in one of which was sulphate of copper in solution, in the other dilute sulphuric acid. On the electric communication being made by placing the yellow sulphuret in the solution, and a piece of zinc in the acid, the change of sulphuret took place, and crystals of native copper were also formed upon it.—Mr. Taylor bore testimony to the importance of geological information to mining agents, who now were informing themselves, not only in practice, but in theory. He spoke of the exertions of the late Mr. Phillips, in drawing up a geological map of Cornwall, so far back as 1800. He suggested the propriety of tracing the lines of fissures into the coal districts, and also wished the direction of the lead lodes of the mountain limestone to be ascertained, as likely to lead general results.—Messrs. Conybeare and Sedgwick made some observations on the importance of making use in geology of such an agent as electro-magnetism.

In the evening meeting, on Tuesday, some interesting, although desultory, communications were made by Professor Phillips and other gentlemen, "on the Distribution of Boulders over the Northern Parts of England."

The Association, he observed, had formerly proposed a question regarding this distribution, and the present was a partial attempt at its solution; and it was interesting both to the geologist and the geographer, as it involved the effects of running water in modifying the surface of a country. In glancing over the north of England, we find a great variety of rock formations, from the oldest slates to the newer tertiary; the country generally slopes to the east, with the exception of the group of Cambrian mountains, which form a local conical zone. One striking feature in its physical geography, is an immense valley running north and south, and passing through a great variety of formations; the Wolds of York being chalk, of Whitby oolite, the Vale of York new red sandstone, while the carboniferous rocks are displayed in Northumberland and Durham. All the country from the Tyne to the Humber is covered with transported boulders, many of which are of rocks quite different from any near the spots where they occur, and some even not recognisable as British rocks. Could Mr. Lyell's ideas regarding the office of icebergs be true, that they had been the means of transporting gravel to distant places? Boulders of the Shap Fell granite had been found in the south-eastern part of Yorkshire; in the interior there were great accumulations of them in many places; their directions seemed all to converge to a certain point, in what is termed the Pennine chain, but on this chain no boulders have been observed, except at one point, from which you look towards Shap Fell; towards the north they have been drifted nearly as far as Carlisle, but there is no trace of them towards the west. We also may find boulders from Carrick Fell carried to Newcastle and the Yorkshire coast, and these have been drifted over the same point of Stainmoor.—Mr. Phillips gave several conflicting opinions of different geologists, to account for this extraordinary transportation: the bursting of the banks of lakes; the alternate elevation and depression of mountain chains; and the supposition that the entire country had been under the sea, when the distribution of boulders had taken place.

Mr. Sedgwick then rose, and remarked, that the direction of transport of the blocks may have been modified by the surface over which they were carried; and that Sir James Hall had been the first who had observed the Shap Fell boulders. These boulders Mr. Sedgwick had noticed on the shores of the Solway Frith, mixed with gravel from Dumfriesshire. He alluded to the action of water upon the crests of mountains, and to the occurrence of transported blocks at considerable elevations. It was well-known that mountain lakes were gradually filling up; and he had shown in a paper to the Geological Society the relation of a lake to the age of the valley containing it. With the diluvial gravel over the country we find associated organic remains—a strong proof that the land must have been dry when the transportation took place.

Mr. Murchison had observed these boulders associated with recent shells at various elevations—consequently, the land must have been at one time under the sea, and have been subsequently elevated. There must have been a relative change of the level of land and sea; and Professor Esmark, in Norway, had been the originator of the idea of the icebergs transporting gravel. He referred to the valley of the Inn, in the Tyrolese Alps, as illustrating this alteration of level: boulders of granite had been found on calcareous mountains composing one of its sides, elevated five or six thousand feet above the sea level, and this valley could not have been scooped out.

Dr. Buckland was of opinion that the land must have been dry before the action of the water that had transported these blocks. There was a great number of organic remains mixed with the gravel, derived from animals existing on dry land; and this was not only true in England, but confirmed by observations in the continent of Europe.

An interesting communication was made on Wednesday by Mr. Stutchbury, respecting "some newly-discovered Saurians in the Magnesian Conglomerate of Durdham Down."

It related chiefly to the specimens exhibited to the meeting, and contained a number of minute anatomical details, which testified in a high degree the industry of Dr. Riley and Mr. Stutchbury, who had examined the specimens; but it would be impossible, without plates, to convey to the reader any accurate notion of these highly-interesting organic remains. They were found in the magnesian conglomerate that rests upon the limestone, and they must have been deposited upon the spot where they were found without violent action, as they bear no marks of attrition; they are often injected with the rocky paste, which has been originally of a viscid character, from its containing blocks of limestone suspended, even near to the surface, and bones have been found near the bottom. Perhaps the most interesting fact mentioned was the peculiar structure of the vertebræ of the newly-discovered saurians, which, from their deeply concave structure, presented a remarkable contrast to those of the recent crocodiles. He showed a singular gradation from the recent saurians to sauroid fishes, by means of this arrangement of vertebræ, which became an excellent guide in the discrimination of the genus of saurus; and he concluded his communication with a quotation from Agassiz, respecting the progressive development of animal life.

Dr. Riley alluded to the extraordinary structure of the cerebral column of these extinct saurians, as likely to illustrate the supposition of Dr. Gall, that the spinal matter of vertebrate would be eventually found to correspond with the ganglionic system of invertebrate animals.—Dr. Buckland was particularly struck with the singular structure of these vertebræ, as indicating in the animal a nervous power of the most extraordinary character. He referred to the extreme interest now excited over the whole globe in the subject of organic remains. He mentioned with great praise the exertions of Lord Cole and Sir Philip Egerton, in devoting their time and money to the forming extensive collections of these remains; and he particularly cited the instance of Bristol, as having at so early a period been distinguished in possessing individuals, who have formed collections of very great value. He mentioned the cabinet of Mr. Johnstone, which contained many specimens inestimable from their great rarity, and of which he had availed himself in drawing up the *Bridgewater Treatise* on Geology. He spoke also of the collection of Mr. Mantell, of that gentleman's immense exertions in the investigation of fossil animals, in particular of the Iguanodon, the gigantic size of the bones of which exceeded any idea we could form, by comparison, with animals now existing. He gave some valuable observations on the specimens described by Mr. Stutchbury, on the form of the teeth and claws of saurians in general. He agreed with Mr. Stutchbury in supposing these remains had been deposited in an undisturbed state, as they bore no marks of violence or rubbing. He spoke of the organic remains of the *Keuper* of Germany, a formation of the same age as the conglomerate under consideration; a magnificent collection of which is at Stutgard, and he brought before the notice of the meeting the Palæologia of Von Mayer, as containing the fullest account, kept up to the present hour, of the discovery of organic remains. It was desirable to search all the formations for fossils, especially as no saurians had been found in the Carboniferous system, and the specimens before the meeting were almost the first discovered in the system of the new red sandstone; he had known of one example only, near Warwick, before the present discovery.—Other specimens, it was stated by a gentleman present, had been found in Warwickshire, and it was also mentioned that a saurian had been seen in the roof of a coal mine near Nottingham: of this fact the members seemed desirous of possessing more certain information.

A rib of one of the Bristol rioters, mineralized by lead, was then exhibited, and drew forth from Mr. Conybeare an announcement of the existence of similarly mineralized bones at Axminster, in the church wall. Dr. Buckland said, they also had been found in repairing part of Christ Church, Oxford. Some antiquarians had supposed the Saxons had a practice of so preserving the bones of their distinguished men, but it was not impossible they might have been the result of accident, as in the case of the Bristol rioter.

A paper was then submitted by Mr. Hopkins, affording theoretical views of the phenomena of elevation, in which he brought forward a series of observations of the highest importance to science in general, and to geology in particular. He entered into the consideration of the mineral veins of Derbyshire, which were fissures filled with mineral matter, with regard to their directions; and the result of his examination of them had been of the most astounding character, namely, that the direction of the axis of dislocation, which had caused the fissure, was true north and south, while that of the structure of the rocks was *magnetic* north and south, thereby showing the connexion between magnetism and the theory of mineral veins. Geology thus came into contact with physical science, and was evidently on its way to a point where it might come within the dominion of the more exact sciences. The mode by which he had obtained this induction, it is not easy to represent without entering into general physical science; but not only did the direct examples confirm the theory, but it was also proved by the exceptions; as in case of a mountain turning aside the force of elevation, and causing the dislocations to radiate from a point in the original axis. He regarded the original structure of a dislocated country, as pointing out the immediate cause of the direction of the fissures when coincided with certain lines of structure, which indicated that the mass was weaker in certain parts than in others, and that the phenomena of anticlinal lines could be readily explained by the same theory, as well as several phenomena of complicated dislocation.—Mr. Sedgwick considered this as the most important communication as yet made to the Section. We should now be enabled to indulge in the same speculations in Geology as in her elder sister science Astronomy, and from the beginning now made, it was impossible to predict how far investigations like Mr. Hopkins's might eventually be carried. The observations of Mr. Hopkins held true in Cumberland, Derbyshire, and Flintshire; and some of his cases of complicated dislocation were admirably illustrated in Carnarvon and Staimore. Mr. Sedgwick had himself paid particular attention to the joints of rocks, and had found them connected both with their strike and dip. He had also observed some singular phenomena in the Westmorland slates; he had seen in them two sets of joints, and in the cleavage, which was in a different direction from the jointing, there was a limit beyond which no further division could be made, unless in certain cases. In South Wales the planes of splitting were in one direction, with very few exceptions.—Mr. Phillips expressed his high satisfaction at the result of Mr. Hopkins's paper, and stated his ardent desire, that the phenomena of geology could be explained by such simple laws as regulate the other branches of physical

science. There was now some hope of resolving the problem, "what is the state of the interior of our planet?" With regard to the structure of rocks, which promised to throw so much light on the subject, he proposed a new term for it, the *symmetrical* structure. In the examination of rocks under the three classes of calcareous, arenaceous, and argillaceous, he had remarked that the regularity of the structure increased with the antiquity of the rock, which was well exemplified in the older slates and limestones. For this there must be a cause, and this must be a central heat, which has been most excited upon the older formations, and least upon the new. Illustrations of the effects of heat upon strata may be obtained from those in contact with dykes, which produce symmetrical structures in rocks or clays through which they pass. Internal heat must then have caused the regular structure so generally observed in rocks. The direction of the fissures pointed out by Mr. Hopkins in Derbyshire, corresponded with the observations of Mr. De la Beche in Cornwall, and of Mr. Conybeare in Glamorganshire. The phenomena of the direction of the joints were well worth investigation, as there was much uncertainty involved. They evidently pointed out the weaker points, or places of least resistance, where the disturbing force would operate with most effect; and they may have been the result of consolidation, as we find them in conglomerates, as well as in homogeneous rocks; still it might be a question, if they were formed before or after dislocation.

On Thursday, Mr. Fox exhibited before the Geological Section the very novel and remarkable experiment we have before described, by which the yellow sulphuret of copper (the common *yellow copper ore* of Cornwall) was converted into the grey sulphuret. After this experiment, he made some observations respecting the electro-magnetic properties of mineral veins.

It was plain that when a rock contained mineral matter, the rock and its contents must be in different electrical states, so that electricity must exist in very great activity in the interior of the globe. He referred to his experiments recorded in the Transactions of the Geological Society. He alluded to the north-east and south-west directions of the Cornish veins, and he had ascertained that there are voltaic currents perpendicular to the magnetic meridian. Tin is found to exist in veins, or in different parts of the same vein; and, in experimenting, he had found that metallic tin went to the positive, and oxyde of tin to the negative pole of the apparatus. He was also struck with a kind of polarization in the disposition of the matter of veins; thus iron and copper presented distinct relations to each other; the grey sulphuret of copper was uniformly found above the yellow: the quartz of north and south veins was striated, that of east and west veins not so. The phenomena of the intersection of veins were also spoken of; the old supposition, that one vein must be older than the other, need not be resorted to in all cases, as it could be proved that crossing veins were often of simultaneous origin.

Dr. Buckland pointed out Mr. Fox's experiment as an illustration of the simplicity of the means which Nature had adopted in her most subtle operations, and expressed his hope that this new application of electro-chemistry to geology would furnish a series of results of paramount importance. Indeed, one of the great benefits conferred by the British Association on science, was the bringing forward individuals who had devoted themselves in private to scientific investigation and experiment, which often, as in the case of Mr. Fox, opened the portals that led to new views of Nature and her operations. He had now to introduce to the notice of the Section another gentleman, who had for many years, in private seclusion, occupied himself in experiments of a novel and extraordinary character, and also making use of apparatus of the most simple description. He then presented to the notice of the meeting Mr. Cross, who would give a verbal account of his most singular proceedings.

Mr. Cross then stated that he had devoted a great part of his life to the pursuit of electricity, and that he came before the Association merely in the character of an electrician, being by no means a geologist, and but in a moderate degree a mineralogist. But, being early impressed with the notion that it would be desirable to produce, if possible, a long-continued, undiminished electrical action, he had set himself to work, and, after many trials, he had constructed an apparatus, which had for no less than an *entire year* retained its electric energy, and this by the agency of pure water only. He had also conceived that it being by long-continued processes that Nature produced most of the effects which we observe, it might be possible to form substances similar to what she affords, by adopting a mode like hers. His attention had been directed to a cavern in the Quantock Hills, in which he had observed calcareous spar incrusted on limestone, and arragonite on clay slate: these minerals had evidently been formed by the water which percolated the rocks. Some of this water he brought to his house, and presented it to the action of his voltaic apparatus; for nine days he anxiously watched for a result, but no visible one offering, he had almost given up the experiment, when, on the tenth day, to his great delight, he succeeded in procuring minerals the same as in the cavern. He was thus encouraged to prosecute further experiments; and, in the course of his investigations, he found that light was unfavourable to the perfection of crystals, he being enabled, in a much shorter period, and with much weaker electric power, to produce them in the dark. He formed several crystals of metallic minerals, but his most successful experiment was the production of quartz from fluosilicic acid, and his inspection of what has been perhaps never before observed by mortal eye, the process of crystalline development from the beginning. He had traced a quartz crystal, first, as a hexagon marked upon the matrix—then lines radiated from its centre—then parallel lines were formed parallel to its sides—it increased in thickness, but, owing to some disturbance of the operation, the process of forming a single perfect crystal was not completed, for a second crystal grew up and intersected it, offering an additional confirmation of the resemblance of Mr. Cross's process to that of nature, where this penetration of crystals into each other is every where to be observed.

It would be extending this report too far to relate all that Mr. Cross communicated to the Section regarding the details of his experiments; but it is impossible to convey an idea of the enthusiasm with which his statement was received by the crowded assembly present. There appeared to be a real *electrical* effect produced upon them; they seemed as if the interior recesses of Nature had been of a sudden laid open to them, and her processes, which had been conceived as past all mortal ken, submitted to their inspection. Mr. Cross was often interrupted during his address with loud peals of applause, which lasted for several minutes after he sat down.

Mr. Conybeare said that he found himself so excited with the intelligence, that he should not submit his observations on the South Wales Coal Basin; he considered any communication he could bring forward totally eclipsed in interest by the overpowering intelligence brought by Mr. Cross.—Upon that gentleman Mr. Sedgwick passed also a highly eloquent eulogium.

Professor Phillips stated that he had now hopes of realizing his fondest dreams of geology. He had long conceived that Nature must have some means of conveying solid matter through solid matter, and that this was now proved by Mr. Cross, whose discoveries were of such an importance, that had the British Association been of no other service than in bringing them to light, they alone were worth all the pains it had taken for the advancement of science, and it was its particular business to have experiments like his set on foot, and prosecuted for many years to come.

Professor Phillips then gave a description of a bed of magnesian limestone, which existed beside Manchester. This limestone he had ascertained to be identical with a similar formation, discovered by Mr. Murchison in Shropshire. He described with great ingenuity the mode by which he had traced this identity by means of shells, which were, in some respects, fluviatile, but rather pointed out a formation formed in an estuary. One of these shells presented a similarity to a young Planorbis, it having a left-handed spire. Remains of fish were also discovered. But the most important point communicated was the relation of the discovery of the Shropshire and Manchester limestones to the future prosperity of the country. The identity of these limestones almost demonstrated that they were at the borders of an *immense coal basin*, extending under the red sandstone of Cheshire, and affording deposits of coal of incalculable quantity, securing to many generations to come a supply of the most important mineral that exists, and dissipating the fears of those alarmists who imagine the decline of the British manufacturing power is not far remote, from the likelihood of the present coal mines being exhausted. He bore honourable testimony to the exertions of D. C. Phillips, of Manchester, who had assisted him in this most interesting investigation.

Mr. Murchison exhibited a map of England, coloured to represent some phenomena of physical geography, and for the purpose of answering a question proposed by the Association. On a former evening Mr. Phillips had given an account of the boulder stones found in the north of England, and which had been traced even as far as Worcestershire. Mr. Murchison, in his researches in Wales and the neighbouring counties, had not observed these carried to the country bounded by the Severn, nor had he observed any of the silurian gravel carried to the central parts of England. From this he concluded that Silaria must have been formed subsequently to this central part, which might have been an island, or part of the continent. In this country of Siluria he had found the deposits of gravel perfectly local; nor could he perceive in this gravel any recent shells: on the borders of the South Wales Coal Basin were marks of diluvial action,—fragments of coal strata being thrown off as from a centre. Another proof of the newer elevation of this part of Britain, are the marks of large lacustrine expanses at recent periods. Out of this tract not only do we observe the boulders of granite extending from north to south, but we find fragments of recent marine shells in the diluvium of Lancashire, Cheshire, Salop, and part of Stafford, all diminishing as we approach the Severn. But he was of opinion that these boulders could not have been so diffused when the surface had been dry land, but that the operation must have been effected under the sea, as proved by the presence of these marine shells, and by the fact of boulders having been found on the summits of the sides of valleys, which could not have been brought to those positions save by the agency of currents of the ocean. This later period of the elevation of Siluria, must have produced also the present course of the Severn. In concluding his remarks, Mr. Murchison mentioned the possibility of icebergs assisting in the transport of diluvium.

Mr. Conybeare mentioned the fact of chalk boulders being found upon Flat Holm, near Bristol, which stones must have been brought down by the Avon.

As Mr. Murchison was desirous that no discussion should take place on the subject of his communication, a conversation was commenced by some of the eminent geologists present, respecting the relation of the structure of rocks to their strike and dip. Mr. Sedgwick proposed several questions respecting these phenomena in different places; these were answered by Messrs. Griffith, De la Beche, and Hopkins, and gave rise to much discussion.

One of the principal communications brought before this Section on Friday was that of Mr. Charlesworth, which we have already given; the proceedings of this day, which terminated the labours of the Section, will not therefore require a very long notice.

A communication was made by Lord Nugent respecting the sea rivulets in the bay of Argostoli, in the island of Cephalonia, referred to at the meeting last year by Mr. Babbage. These streams flowed *from* the sea *into* the land, and one of them had been employed to turn a mill. Many hypotheses had been started to account for such a phenomenon; some supposing a difference of level on different sides of the islands, and that the streams flowing through a subterranean tunnel restored the equilibrium; others supposed, that some volcanic relations were involved, although there does not exist any recent volcanic formation in the neighbourhood, and during an earthquake no effect was produced upon these rivulets.

Mr. Murchison, referred to the chemico-geological theory, which accounts for volcanic phenomena, by the sea water being admitted to act upon certain inflammable bases in the interior of the globe; and he requested Dr. Daubeny to favour the Section with some of his views on that subject.

Dr. Daubeny said, that he had long been an advocate for the theory of volcanos originally proposed by Sir H. Davy, and considered the fact mentioned by Lord Nugent as confirmatory of it. It seemed, at least, to establish one of the conditions of the above theory, namely, that sea water really does find admission into the bowels of the earth; and although Cephalonia itself may not be volcanic, yet many of the neighbouring islands are, and in these, even where volcanic eruptions are absent, earthquakes are common, and subterranean noises, which may be regarded as the results of volcanic action, are heard. With respect to the opposite theory of volcanos, which had been maintained the other evening by Professor Sedgwick, Mr. Whewell, &c., he would say thus much, that, as he had never pretended to do more than to show, that the present phenomena of volcanos implied chemical action, he was quite ready to leave the mathematicians to settle it between them, whether the earth had been originally in a state of fluidity or not. He thought, however, that, as man had as yet scarcely done more than scratch the surface, it was rather rash to conclude, that, because, so far as we had yet gone, an increase of temperature had been observed, therefore the same law held good, even to the centre of the earth. Such an inference resembled what might have occurred in Lilliput, had the philosophers of that island, in their examination of the contents of Gulliver's pockets, chanced to have discovered an orange. This huge globular mass would have, doubtless, excited such curiosity, and would have first been rolled on to the Geographical Section of the great Lilliputian Association, whose members after circumambulating its circumference, and taking a map of the inequalities and depressions of its rind, would have referred it to the more particular examination of the geologists. The latter, not content with so superficial an examination, would, by dint of labour, succeed in piercing the rind; but in attempting to penetrate the white, would soon find themselves stopped by its tough and leathery texture, which would be denser and tougher the farther they descended into it. Unable, therefore, to get any farther, and utterly ignorant of the pulp in the middle, these philosophers would here have finished their labours, and, in the spirit of the advocates of the central heat theory, might have reasoned, if the density and toughness of the portion of the orange we have pierced through increases in the above ratio, what must the density and toughness of the same leathern substance be at the centre?

Mr. Greenough then addressed the assembly respecting the discoveries communicated by Mr. Cross on the day before. He said, that in their admiration of these discoveries, which were perfectly original, and made without knowledge of the labours of others, the Section must not forget that justice was also fairly due to certain foreign chemists, who had prosecuted a similar line of investigation. He read a passage from Dr. Buckland's Bridgewater Treatise, to show that M. Becquerel had also formed minerals by means of electricity; and he mentioned the names of Berthier, Rose, and others who had succeeded in the same path. Still, the highest praise must be awarded to Mr. Cross for his originality.

The concluding paper read before this Section was one by Professor Forbes, detailing several remarkable facts which he had observed, showing the connexion of thermal springs with the development of granitic and other pyrogenous rocks.

During his travels in the Pyrennees, he had traced a remarkable connexion between the hot springs of that district with its geology. He had found that the granite of that country had acted upon the other rocks in such a manner as to show extreme cases of disturbance, and that, round the lines that marked the connexion of these rocks with granite these springs were certain to be observed; also mineral veins were certain to abound in the same situations—so that four co-ordinate facts had been determined,—the presence of granite, its alteration of the adjacent rocks, the vicinity of veins, and the position near to them of mineral springs. A number of interesting facts regarding the temperature of these springs were mentioned; also an account of the examination of a spring, whose temperature had been accurately ascertained one hundred years ago, and last year by Professor Forbes, who found the thermometer stand at the same point as that recorded in the last century. He represented the springs of the Eastern Pyrennees as by far the most remarkable.—Mr. Sedgwick asked, could this granite be yet *cold?* It would prove the opinion, that the granite of the Pyrennees is very recent. He mentioned how often igneous rocks were found near hot springs, and it was plain that the cracks made by the protrusions of these rocks were so many moulds for the reception of mineral matter.—Mr. Clark instanced his observations on a well at Poole, Dorsetshire, the temperature of which never varied from 51½° at any season or time.

The extreme value and importance of the various facts and researches brought before the Geological Section, must be sufficiently apparent to every cultivator of this interesting science. It will be seen that we have now reasonable hopes of that close connexion being established between Geology and the exact sciences, which will raise it to a rank there was some years since little probability of its ever attaining.

[*To be concluded in our next.*]

ON THE COAL-FIELDS ON THE NORTH-WESTERN COAST OF CUMBERDAND.

BY THE REV. PROFESSOR SEDGWICK, M.A., F.R.S., F.G.S., AND WILLIAMSON PEILE, ESQ., OF WHITEHAVEN, F.G.S.

In a paper read at one of the meetings of the Geological Society, the authors described the range of the carboniferous limestone from the neighbourhood of Kirkby Stephen to Egremont; and showed that the formation admitted of two divisions: the lower representing the scar limestone of the Yorkshire sections, the upper (also like the Yorkshire sections) exhibiting alternations of limestone, sandstone, and shale, with thin seams of coal. They commenced with a short notice of rocks and sections made through this upper division, which in its range towards the western coast of Cumberland, appears gradually to thin off, and lose its importance. They then proceeded to describe in more detail, and with many illustrative sections, a still higher coal-field; which is on the same parallel with the great Northumberland and Durham coal-fields, and in the quantity of carboniferous beds subordinate to it, is in no respect inferior to them.

This field is bounded by the red sandstone of St. Bees Head; by the carboniferous limestone, in a part of its range above described; by the seacoast between St. Bees Head and Maryport; and by the new red sandstone in its range from Maryport to Chalk Beck, near Rosley. The whole system appears to thin off near Rosley, and is succeeded by some sterile, alternating, masses of red shale and sandstone, to which the miners, though improperly, have given the name of the "great red metal dyke." To the east of this series of red beds the rich upper coal-field never appears to have extended. From many borings and workings near Whitehaven, it is inferred that the upper division of this carboniferous limestone, as well as the millstone grit, have almost disappeared; and that the coal measures are brought nearly into immediate contact with the lower division of the limestone. In some places the whole limestone has thinned off, and the coal measures seem to rest almost immediately on the Skiddaw slate.

The authors commence their details, in the present paper, with an account of the Whitehaven coal-field, which they separate into three divisions; the southern, or How-Gill colliery; the middle, or Town field bounded by a great downcast dyke towards the north; and the northern, or Whin-Gill colliery, bounded by an anticlinal line which enters the sea near Parton. The strata found in these several parts of the field are described by the help of the sinkings and borings at Croft Pit, and by other sinkings in various parts of the field down to the limestone. A comparison is then made between this series of strata and those exhibited in corresponding sections of the Harrington and Workington fields; and it is shown that the whole series may be conveniently separated into two divisions; the upper, containing two principal bands of coal, called the "Bannock Band," and Whitehaven "Main Band;" the lower, containing many thin seams of coal, but only one band which has been much worked near Whitehaven. They then proceed to describe the most remarkable workings in the several divisions of the Whitehaven field; the new field to be approached by the Parton tunnel; and the extension of the "Main and Bannock band" to the hills S.E. of Dissington; but these details, as well as an account of the works attempted in a small triangular field bordering the sea to the north of Parton, are necessarily passed over in this abstract.

They then describe the Harrington coal-field, bounded to the north and south by two enormous faults; between which the country is occupied by the lower division of the coal measures. It is impossible in an abstract to describe the complicated *faults* that every where intersect this field, and by which the limestone is in two instances brought up to the surface. The coal beds, worked within it, are five in number, and are described, in descending order, under the following names:—(1.) Metal Band: (2.) Two-feet Band: (3.) Yard Band: (4.) Four-feet Band: (5.) Yeadale Band. By help of a transverse section to Castlerigg, this field is connected with the upper division of the coal measures; inasmuch as pits have been sunk near that place, through the great beds of the upper division, down to the *two-feet band*; thus giving a consistency and unity to all the sections.

The authors next describe the Workington field, bounded to the south by the great *fault*, which brings in the lower division of the Harrington field, and to the east and west by the sea and the turnpike road. The river Derwent was formerly regarded as its northern boundary; but the *main band* unfortunately thins out a little to the south of Workington, and thereby contracts the extension of the valuable part of this field. Nearly all the beds worked in this field belong to the upper division; and their general agreement with the Whitehaven bands of coal is proved by detailed sections; especially from the sinkings at Henry Pit near the mouth of the Derwent. The principal *faults* traversing this district, the outcrops of the principal bands of coal, and the extension of the works under the sea, are described in some detail. Several other small divisions of the great field are then noticed; viz. the Starmire, Keekhill-Side, Brownrigg, Branthwaite-Edge, Gillgarron, and Graysouthern fields; after which the authors proceed to describe the phenomena on the north side of the Derwent.

To the north of the Derwent, there is near the sea-coast a sterile region, partly occupied by the *lower red sandstone*, and partly by the upper divisions of the coal measures in which the main coal is wanting; a fact connected with the thinning off of the *main band* to the south of Workington. In an very extensive field, commencing a little to the N. of the village of Seaton, and extending over Broughton Moor, and from thence to Dearham, two beds of coal (known by the names of the "ten-quarter band" and the "horned and metal band") have been very extensively worked, and are identified with the *bannock band* and *main band* of Whitehaven and Workington. The relations of the several parts of this extensive tract of country are exhibited in detailed sections, of which it is very difficult to convey a notion in a mere abstract; and the works carried on within the mare, with very limited exceptions, referred to the upper division of the Whitehaven field.

The coal bands exhibited in the works near Gillcrux, Aspatria, Plumland, and Weary Hall, are then described, and detailed sections are given of the works in the Bolton field—generally regarded as the north-eastern limit. There is, however, an unexplored tract to the east of a great fault which forms the northern limit of the Bolton field; and, in the neighbourhood of Rosley, a seven feet coal (undoubtedly a member of the upper division) was formerly worked, to a very small extent, in consequence of the complicated dislocations which intersect the district.

Having described, in the above order, the several portions of the great coal field, and noticed some of its peculiarities of mineral structure, the authors endeavour to ascertain the limits of certain outlying masses of the *lower red sandstone*, of the *magnesian conglomerate*, and of the *new red sandstone*. From the facts stated, it appears that the coal measures pass, in some instances, in regular ascending order, into the lower red sandstone. In other instances, however, the coal measures appear to have undergone considerable movements of elevation before the existence of the lower red sandstone, inasmuch as the position of the two formations is discordant. Again, though the lower red sandstone forms the natural and immediate basis of the magnesian limestone and conglomerates, yet there are several places, within the south-western limits of the country described, where the conglomerates appear to have been deposited in hollows and inequalities presented by the water-worn beds on which they rest unconformably. From which facts it seems to follow that the formations described in this paper have undergone, during their development, two considerable movements, affecting the position of the component strata; 1st, a partial movement of the coal measures, anterior to the deposition of the lower red sandstone; 2ndly, a partial movement, both of the coal measures and the lower red sandstone, anterior to the formation of the magnesian conglomerates.—*Proceedings of the Geological Society.*

HEIGHTS OF THE PRINCIPAL MOUNTAINS ABOVE THE LEVEL OF THE SEA.

EUROPE

	Feet.		Feet.
Mont-Blanc, Alps	15,662	Adelat, Sweden	5,180
Mount Rosa, do.	15,530	Hecla, Iceland	5,000
Oertler Spitze, Tyrol	15,430	Mount Giant, Bohemia	4,900
Corn du Midi, Alps	14,270	Puy-de-Dome, France	4,846
Finsterahorn, Switzerland	14,000	The Balloon, Vosges	4,620
Jung-Frau, do.	13,710	Ben Nevis, Scotland	4,380
Mulahasen, Grenada	11,700	Ben Lawers, do.	4,020
Mont-Perdu, Pyrenees	11,270	Ben More, do.	3,870
Col-de-Géant, Alps	11,140	Mount Parnassus, Spitzbergen	3,750
Vignemale, Pyrenees	11,010	Snowdon, Wales	3,570
The Cylinder, do.	10,930	Carnedd Lewellyn, do.	3,469
Ætna, Sicily	10,616	Macgillicuddys, Ireland	3,400
Budsiaw, Transylvania	9,800	Schinaillen, Scotland	3,380
Surul, do.	9,800	Ben Lomond, do.	3,340
Legnone	9,200	Sea Fell, England	3,166
Canigou, Pyrenees	9,100	Helvellin, do.	3,055
Point-Lomnitz, Carpath	8,860	Skiddaw, do.	3,022
Monte-Rotondo, Corsica	8,709	Pillar, do.	2,892
Monte-d'Oro, do.	8,630	Bow Fell, do.	2,911
Liptz, Carpath	8,310	Cross Fell, do.	2,901
Snechattan, Norway	8,200	Saddleback, do.	2,787
Olympus, Greece	6,520	Grassmere Fell, do.	2,756
Lacha, do.	6,520	Cheviott, do.	2,658
Mont-d'Or, France	6,510	Nephin, Ireland	2,634
Sierra-d'Estre, Portugal	5,580	Mourne, do.	2,800
Puy-Mary, France	5,440	Wernside, England	2,384
Kassberg, Summit, Styria	5,220	Ingleborough, do.	2,361
Hussoko, Moravia	5,326	Pennigant, do.	2,270
Schneekoppe, Bohemia	5,240	Kilhope Law, do.	2,190

AMERICA.

Chimborazo, Peru	21,441	Gargaviraco, Peru	15,640
Cayamba Urca, do.	19,388	Huanca Velica	13,600
Antisana, do.	19,149	Cofre de Perote, Mexico	13,260
Cotopaxi, do.	18,820	Mount Elias, North America	12,670
Potasi, summit of, do.	18,000	Tolucca, Lake of, Mexico	12,200
Ilinissa, do.	17,240	Pico de Tancitaro, New Spain	10,500
Catacatche, do.	16,436	Blue Mountains, Jamaica	7,278
Sierra Merida, do.	16,420	Sulphatara, Guadaloupe	5,100

ASIA.

Himalaya Mountains, Nepal	27,700	Petcha, Chinese Tartary	15,000
Yumunavatari	25,500	Soomoonang, Bootan	14,000
Dhailun	24,740	Ghassa, do.	13,000
In the Valley of Nepal	24,625	Mount Ophir, Sumatra	13,600
Another Peak in do.	23,050	Ararat, Turkey	9,000

Caspian Sea 306 feet below the Atlantic.

AFRICA.

Peak of Teneriffe	12,220	Gondar Mountains, Abyssinia	8,436
Atlas, highest Peak of	11,980	Monte de Tugo, Canaries	7,429
Lamalmon, Abyssinia	11,200	R. Entre-deux, Isle of Bourbon	6,000
Compass Mountain, Cape of Good Hope	10,000	Bonnet Pointon, do.	6,000
Gros Morne, Isle of Bourbon	10,000	Ruino, Madeira	5,160

PURIFICATION OF COAL-GAS.—Mr. H. Phillips, superintending engineer of the Exeter Gas Works, has discovered the means of arresting the volative alkalis, to which, from its known corrosive property, when in contact with copper or brass, is to be attributed the destruction of cocks, fittings, and meters; and as azote (one of the constituents of ammonia) is highly injurious to respiration, that peculiarly pungent and obnoxious quality of the air in rooms in which coal-gas is burnt for a long portion of the night is probably augmented, if not produced by it, from the circumstance of the ammonia not being previously separated; azote is alike injurious to combustion; by employing two burners of the same size, and supplying one with gas from which the ammonia has been removed, and the other with gas from which ammonia has not been removed, the superiority of the light produced by the one over that produced by the other will be clearly apparent. Mr. Phillips has taken out a patent for his discovery.—*Worcester Journal.*

JOINT-STOCK BANKS.

The appendix to the report of the committee on joint-stock banks contains answers from sixty-three such institutions to the questions in Mr. S. Rice's circular; and as the results are in the highest degree important to the whole country, we have reduced those answers into a brief narrative, exhibiting the state of each joint-stock bank.

HULL BANKING COMPANY.

Commenced business December 2, 1833; has fifteen branches, the nearest nine, and the farthest forty miles distant; nominal capital 800,000*l.*, in 8000 shares of 100*l.* each; 4220 shares have been issued, on which 50,750*l.* has been paid; divided 5 per cent. in the first, and 6 per cent. in the second year; 245 proprietors have signed the deed of settlement; accounts are laid before the proprietors, audited by five directors, who make annually a declaration that they are worth 5000*l.*; fifty shares a qualification for directors; the bank holds none of its shares or stock, except as a lien for advances, the amount of which is 8842*l.*; such advances for not more than four months; pays its promissory notes in practice at all, but of right only in four of the branches, and in London; allows 3 per cent. on deposits, if for more than two months, and on current accounts.

LEEDS BANKING COMPANY.

Commenced December, 1832; nominal capital, 1,000,000*l.*, in 10,000 shares of 100*l.* each; up to May, 1836, 7740 shares allotted; paid up capital, 116,000*l.*; twenty shares forfeited for non-payment of instalments; divided 7½ per cent. for 1834, 8 per cent. for 1835; 554 signatures to the deed of settlement; 461 partners at this time; holds none of its own stock; has no branches; pays notes in Leeds and in London; pays 2½ per cent. on deposits, and 2 per cent. on accounts current; furnishes a statement to an annual meeting, and the proprietors, if dissatisfied, may appoint auditors who are not directors.

YORK CITY AND COUNTY BANKING COMPANY.

Commenced March, 1830; has five branches, the nearest fourteen, the farthest forty miles distant; nominal capital, 500,000*l.*, in shares of 100*l.*; paid up capital, 75,000*l.*; dividends—for 1831, 6; 1832, 8; 1833, 10; 1834, 12; and for 1835, 12 per cent.: 310 signatures to the deed of settlement, and sixty-six to a supplemental deed; reports to proprietors presented annually; holds none of its own shares or stock; notes payable at the places where issued; 2½ per cent. paid on deposits for two months; if above 500*l.*, and for twelve months, 3 per cent.

COVENTRY UNION BANK.

Commenced May, 1836; has no branches; nominal capital, 200,000*l.*; 10,000 shares, 20*l.* each; 5610 shares issued; capital paid, 28,050*l.*; deed of settlement not yet printed; no return of signatures; holds none of its own shares; pays its notes in London.

WEST OF ENGLAND AND SOUTH WALES DISTRICT BANK.

Commenced December, 1834; has nine branches, the nearest twelve, the farthest ninety-nine miles distant; eight agencies, the nearest eighteen, the farthest 110 miles distant; nominal capital, 1,000,000*l.*; 50,000 shares, 20*l.* each; 21,000 shares issued; capital paid up, 209,882*l.*; dividend 5 per cent.; date of deed of settlement, February, 1835; number of signatures, 401; deed published, February, 1835; proprietors at any general meeting have power to elect three proprietors as auditors of the directors' report; holds none of its own shares; promissory notes and bank post-bills payable at the various branches, and at Glyn, Halifax, and Co.'s, London; bank post-bills issued at seven days' sight, or eleven days' date; 2 per cent. paid on deposits left as such, and 2½ per cent. on a stamped interest note payable at twenty-one days' sight.

STUCKEY'S BANKING COMPANY.—(SOMERSETSHIRE BANK.)

Commenced in 1826; has sixteen branches, all in Somersetshire (Bristol included), and none exceeding forty miles distant; original capital, 200,000*l.*; additional capital, 100,000*l.*; 2000 original shares, and 1000 increased, 100*l.* each; 2800 shares issued; capital paid up, 60,000*l.*, exclusive of the reserve fund; declared dividend, 2*l.* per share half-yearly; date of deed of settlement, September, 1831; signatures, thirty-five; accounts made out at the branches respectively, and examined at the head office; holds none of its own shares; pays promissory notes and bank post-bills where issued; pays from 2 to 3 per cent. on deposits, but gives no interest on drawing accounts; accounts made up to the 30th of June and 31st of December, in each year.

DUDLEY AND WESTBROMWICH BANK.

Commenced January, 1834; no branches; nominal capital, 400,000*l.*; 8000 shares, 50*l.* each; 6005 shares issued to December, 1835; capital paid up, 30,025*l.*; declared dividend, 6 per cent. for 1835, 5 per cent. for 1834; date of deed of settlement, December, 1833; signatures, 209; copy of deed printed, December, 1833, and distributed to shareholders; has a lien on all shares held by individuals for any sum they may be indebted to the bank; shares not disposed of reserved for the purpose of being allotted to those who may open accounts in future; promissory notes paid at Dudley and Westbromwich and London; post-bills payable in London; pays 2, 2½, and 3 per cent. on deposits and balances; accounts made up to the 31st of December, 1835.

COVENTRY AND WARWICKSHIRE BANKING COMPANY.

Commenced January, 1836; one branch at Nuneaton, eight miles distant; nominal capital, 400,000*l.*; 8000 shares, 50*l.* each; 7000 shares issued; capital paid up, 35,000*l.*; no dividend declared; date of deed of settlement, December, 1835; signed by 265 proprietors; deed not printed; 1000 shares not allotted; 100 shares held as security; pays promissory notes at Coventry and London; pays 2, 2½, and 3 per cent. on deposits and balances.

LIVERPOOL TRADESMEN'S BANK.

Commenced April, 1836; no branches; nominal capital, 250,000*l.*, with power given to the directors to increase such capital to 400,000*l.*; 25,000 shares, 10*l.* each; 18,420 shares issued, and more are issued daily as accounts are opened with the bank; capital paid up, 46,050*l.*, or 2*l.* 10s. on 18,420 shares, and 4577*l.* 10s. premium on those appropriated, making 50,627*l.* 10s.; date of deed of settlement, April, 1836; 174 signatures already, and deed still open; holds 6580 unappropriated shares in trust for the general proprietory of the bank; has a lien on the shares of all parties indebted to the bank; has no promissory notes, not being a bank of issue; pays post-bills and draughts in London; pays 2½ per cent. on deposits, and from 3 to 4 per cent. on balance of current accounts; accounts made up to the 31st of December next, and subsequently on the 30th of June and the 31st of December.

BRADFORD BANKING COMPANY.

Commenced June, 1827; no branches; nominal capital, 500,000*l.*; 5000 shares, 100*l.* each; 3865 shares issued; capital paid up, 101,146*l.*; declared dividend, 10 per cent.; the dividends of 1828, 1829, 1830, and 1831, were 7½ per cent. per annum. A further issue of shares being made in June, 1831, it was determined in 1832 that the old proprietors should have a dividend of 8½ per cent., and that both old and new proprietors should have a further dividend of 5 per cent.; dividends in 1834 and 1835 were 7½ per cent.; date of deed of settlement, June, 1827; signatures to it, 199; balance-sheet to 31st December, 1835, shows a profit of 12,000*l.*; has a lien on all shares belonging to proprietors, on which advances are made; pays promissory notes at Bradford only; does not issue bank post-bills; draws bills of exchange on Messrs. Jones, Loyd, and Co., London; pays 2½ per cent. on deposits under six months, and 3 per cent. for a longer period; 2½ per cent. on balances of current accounts; charges a commission of 5s. per cent. on all sums for which accounts stand debited; in February, 1830, the rate of interest was reduced to 2 per cent. under six months, and to 2½ per cent. above that date; present rate restored in June, 1831; accounts made up to 31st December, 1835.

UNION BANK OF MANCHESTER.

Commenced May, 1836; has no branches; nominal capital, 600,000*l.*; 24,000 shares of 25*l.* each; 19,630 shares issued; capital paid up, 49,075*l.*; twenty shares forfeited; deed before counsel; 4370 shares retained by the directors to be granted to parties who open accounts; account made up to the 28th of May, 1836.

LIVERPOOL UNITED TRADES' BANK.

Commenced May, 1836; has no branches; nominal capital, 400,000*l.*; 20,000 shares, 20*l.* each; 10,000 shares already issued; applications greatly exceed the remaining number; 6*l.* 10s. per share paying up; date of deed of settlement, April, 1836; in course of signature.

GLOUCESTER COUNTY AND CITY BANK.

Commenced January, 1835; has no branches; nominal capital, 100,000*l.*; 200 shares, 500*l.* each; 116 shares issued; capital paid up, 19,720*l.*; declared dividend, 3*l.* per share; date of deed of settlement, March, 1835; signatures to it, twenty-three; pays from 2 to 3 per cent. on deposits; none on balances of account; holds none of its own shares; accounts made up to the 31st of December, 1835.

(LEITH BANK OFFICE.)

No return.

PARES'S LEICESTERSHIRE BANKING COMPANY.

Commenced as a private bank in 1800; converted into a joint-stock bank in March, 1836; has no permanent branches; offices open on market and fair days at Hinckley, thirteen miles; Loughborough, eleven; and Melton Mowbray, fifteen miles distant from Leicester; nominal capital, 100,000*l.*; 8000 shares, 12*l.* 10s. each; 6330 shares issued; capital paid up, 15,825*l.*; date of deed of settlement, March, 1836, with thirty-nine signatures; holds none of its own shares; pays promissory notes at Leicester and London; does not issue bank post-bills; until 1830 paid 3 per cent. interest, then reduced to 2 per cent., raised in 1832 to 2½ per cent., and continues thereat; account made up to the 25th May, 1836.

BIRMINGHAM BANKING COMPANY.

Commenced October, 1829; has no branches; nominal capital, 500,000*l.*; 10,000 shares, 50*l.* each; 10,000 shares issued; capital paid up, 50,000*l.*, increased by 26,111*l.* reserved out of profits; 388 shares forfeited by shareholders becoming insolvent and in debt to the company: declared dividend 10 per cent.; date of deed of settlement, October, 1829, signed by 321 persons; balance-sheets made out on the 30th of June and the 31st of December, and an abstract printed and published; makes no advances on shares; holds no shares in trust; has never issued promissory notes but those of the Bank of England; pays bank post-bills in London; pays 2 per cent. on balances of account; 2½ per cent. on deposits, and 3 per cent. on large deposits under special agreement; account made up to the 31st of December, 1835.

WAKEFIELD BANKING COMPANY.

Commenced November, 1832; has no branches; nominal capital, 300,000*l.*; 6000 shares, 50*l.* each; 5605 shares issued; capital paid up, 44,840*l.*; 1st, 2d, and 3rd dividend, 6 per cent.; 4th dividend, 8 per cent.; dividend January, 1836, 2 per cent.; date of deed of settlement, December, 1832, signed by 220 shareholders; deed printed in February, 1833; has a lien on shares of persons indebted to the bank; pays promissory notes at Wakefield and London; pays from 2 to 3 per cent. on deposits, and 2 per cent. on balances; account made up to the 31st of December, 1835; but the answers include the period up to the 25th of May, 1836.

DARLINGTON DISTRICT JOINT-STOCK BANKING COMPANY.

Commenced January, 1832; has four branches, the nearest twelve, the farthest seventeen miles distant; nominal capital, 400,000*l.*; 4000 shares, 100*l.* each; 3695 shares issued; capital paid up, 55,425*l.*; dividend in 1833, 11 per cent.; in 1834, 8 per cent.; and in 1835, 10 per cent.; date of deed of settlement, January, 1832; signed by 285; deed printed; pays promissory notes at Darlington, and draughts in London; pays 3 per cent. on balances and deposits of and above three months; accounts made up to December 31, 1834; June 30, 1835; December 31, 1835; and May 28, 1836.

LIVERPOOL COMMERCIAL BANK.

Commenced January, 1833; has no branches; nominal capital, 500,000*l.*; 50,000 shares, 10*l.* each; 24,440 shares issued; capital paid up, 244,000*l.*, exclusive of the reserve surplus fund; dividend in 1834, 5 per cent.; in June, 1835, 3 per cent. for the half-year; December 31, 1835, 3½ per cent. for the half-year; date of deed of settlement, January, 1833; signed by 292; deed printed in March, 1833; has a permanent lien on all its own stock for the liabilities of every proprietor, whether solely or in partnership; issues no promissory notes or bank post-bills; pays on deposits 2½ per cent., or 3 per cent., subject to a commission of ¼ per cent. when drawn out, the rate an exception; 3½ per cent. on balances, subject to ¼ per cent. commission; discounts bills at the market rate of the day, and by momentary bargain; accounts made up to the 31st of December, 1834; the 30th of June, 1835; and the 31st of December, 1835.

WHITEHAVEN JOINT-STOCK BANK.

Commenced June, 1829; has one branch at Penrith, forty-four miles distant; nominal capital, 300,000*l.*; 3000 shares of 100*l.* each; 2805 shares issued; capital paid up, 28,050*l.*; declared dividends—three of 10 per cent. and two of 8 per cent.; variations in dividends—August, 1831, 10 per cent.—namely, 7½ per cent. amongst the shareholders, and 2½ per cent. to surplus fund; Aug., 1832, 10 per cent., with the same reservation; Aug., 1833, 8 per cent.—namely, 6 per cent. to shareholders, and 2 per cent. to surplus fund; August, 1834, 8 per cent., with the same reservation; and August, 1835, 10 per cent., with the same reservation as made in 1831 and 1832; date of deed of settlement, April, 1829, signatures to it, 238; holds sixty of its own shares; pays promissory notes and bank post-bills at Whitehaven; pays 2½ per cent. on deposits and balances; account made up to April, 1836.

NORTH AND SOUTH WALES BANK.

Commenced May, 1836; head office, Liverpool; has two branches, one in Merionethshire, and the other in Carnarvonshire, both between seventy and eighty miles distant; nominal capital, 600,000*l.*; 60,000 shares, 10*l.* each, to be all called up; upwards of 20,000 shares issued; capital paid up, nearly 20,000*l.* on the first call, and 5000*l.* on second call; date of deed of settlement, June, 1836; account made up to 21st of May, 1836.

BANK OF STOCKPORT.

Commenced May, 1836; no branches; 12,740 shares issued; capital paid up, 31,850*l.*; deed of settlement not drawn out; pays 2½ per cent. on deposits, and 3 per cent. on balances of accounts.

YORK UNION BANKING COMPANY.

Commenced May, 1833; has four branches, the nearest eighteen, the farthest thirty-six miles distant; nominal capital, 700,000*l.*; 7000 shares of 100*l.* each; 5745 shares issued; capital paid up, 57,450*l.*; declared dividend, 8 per cent.; dividend for 1834, 7 per cent.; for 1835, 8 per cent.; date of deed of settlement, May, 1833, signatures to it, 260; makes advances occasionally on its own shares to customers; holds 1255 shares to be issued to those who open accounts; pays promissory notes at York, Driffield, Burlington, Thirsk, Malton, and at London; pays bank post-bills in London only; pays 2½ per cent. on running deposits, and 2 per cent. on accounts current; pays 3 per cent. on deposits to remain for twelve months, but if withdrawn within that time, then only 2 per cent.; account made up to 31st December, 1835.

WOLVERHAMPTON AND STAFFORDSHIRE JOINT-STOCK BANKING COMPANY.

Commenced January, 1832: has no branches; nominal capital, 500,000*l.*; 10,000 shares of 50*l.* each, all issued; capital paid up, 50,000*l.*; dividend in 1832, 5 per cent.; in 1833, 1834, and 1835, 6 per cent.; date of deed of settlement, December, 1831, signed by 287; shares of customers liable for any amount they may owe the company; pays re-issuable notes at Wolverhampton and London, bank post-bills in London only; interest on deposits and balances never exceeds 3 per cent; account made up to May 26, 1836.

LIVERPOOL UNION BANK.

Commenced May, 1835; has no branches; nominal capital, 600,000*l.*, with power to increase to 1,000,000*l.*; 30,000 shares of 20*l.* each; 17,170 shares issued; capital paid up, 171,750*l.*; date of deed of settlement, May, 1835; signatures to it, 235; has a lien on the shares of the proprietors who may be indebted to the company; has advanced 36,620*l.* to forty-six individuals, on 4950 shares, being an average of 8*l.* per share on 10*l.* paid; pays 3½ on balances on current accounts, 2½ per cent. on deposits; accounts made up to December 3, 1835.

CHELTENHAM AND GLOUCESTERSHIRE BANK.

Has no branch; nominal capital, 500,000*l.*; 10,000 shares of 50*l.* each; 3000 shares issued; capital paid, 15,000*l.*; date of deed of settlement, May, 1836, signatures to it, 116.

HALIFAX JOINT-STOCK BANKING COMPANY.

Commenced November, 1829; has no branches; nominal capital, 500,000*l.*; 5000 shares of 100*l.* each; 3925 shares issued the 31st of December, 1835; capital paid up, 39,225*l.*; dividend in February, 1831, 6 per cent.; in 1832, 12½ per cent.; in 1833, 16 per cent.; in 1834, 16 per cent.; in 1835, 12½ per cent.; and in 1836, 12½ per cent.; date of deed of settlement, November, 1829, signed by 186, and published March, 1831; holds 1075 unappropriated shares; pays promissory notes and bank post-bills in Halifax and London; pays 3 per cent. on permanent deposits, and from 3 to 4 per cent. on fluctuating balances; account made up to the 31st of December, 1835.

HUDDERSFIELD BANKING COMPANY.

Commenced June, 1827; has no branches; has two agencies, but no accounts kept at them; nominal capital, 700,000*l.*; 7000 shares of 100*l.* each; 6500 shares issued; capital paid up, 65,000*l.*; about twenty shares forfeited in June, 1827, but no instalments had been paid on them; dividend in 1829, 6 per cent.; in 1830, 5 per cent.; in 1831, 6 per cent.; in 1832, 6 per cent.; in 1833, 19 per cent., which included 13,000*l.* of the reserved surplus fund, which was divided amongst the old shareholders previous to the admission of new; in 1834, 6 per cent.; and in 1835, 8½ per cent.; date of deed of settlement, June, 1827, signed by 369; supplementary, August, 1833, signed by 376; deed printed in 1827; supplementary deed in 1833; holds 180 of its own shares, which it purchased at several sales; has a lien on all shares held by customers; pays promissory notes at Huddersfield and London; pays 3 per cent. on deposits, 4 per cent. on current accounts; rate of interest has fluctuated from 2½ to 3 per cent.; account made up to December 31, 1835.

SADDLEWORTH BANKING COMPANY.

Commenced March, 1833; converted from a private bank established in 1806; has two branches, four and seven miles distant; nominal capital, 300,000*l.*; 6000 shares of 50*l.* each; 5930 shares issued; capital paid up, 29,650*l.*; dividend for the half-year ending June 30, 1835, 5 per cent.; first dividend made was 7½ per cent. in 1835, the rate altered to 10 per cent.; date of deed of settlement, September, 1833, executed by 124 proprietors; holds thirty of its own shares, and has a lien on all shares in case of need; notes of the bank paid at the branches, and in London; pays 2½ per cent. on deposits, or 3 per cent., subject to a commission of ¼ per cent. on withdrawal, 4 per cent. on current accounts; account made up to December 31, 1835.

LINCOLN AND LINDSEY BANKING COMPANY.

Commenced August, 1833; has two branches, twenty-one and twenty-seven miles distant; four agencies, the nearest sixteen, the farthest forty miles distant; nominal capital, 250,000*l.*; 1250 shares, 200*l.* each; 1000 shares issued; capital paid up, 20,000*l.*; dividend 6 per cent.; date of deed of settlement, August, 1833, with 248 signatures; shares of the customers held liable for any advances; pays 2 per cent. on deposits and balances; promissory notes and bank post-bills payable at Lincoln, Louth, Gainsborough, and London; account made up to 31st of December, 1835.

(To be continued.)

ON CIVIL AND MINING ENGINEERING.

BY T. SOPWITH, C.E., F.G.S.

The universities of this kingdom and numerous public schools afford ample opportunities of acquiring general knowledge, but there is not throughout the whole of this great commercial and manufacturing country any establishments which are expressly adapted to that kind of knowledge in which the vital strength of this and every other nation really consists.

With every feeling of respect for classical literature, not only as an ornamental, but as a firm and enduring basis of human knowledge, it is our conviction that it occupies a greater share of time and attention in the routine of education generally, than it is entitled to in a country where practical skill and an intimate acquaintance with art and science are so much required of by far the larger class of society. The establishment of academics for this latter description of learning is yet a desideratum, and it is one which, we trust, the increasing knowledge and activity of the present age will speedily accomplish.

It is true, that in latter years the universities have been more and more enlightened by the progress of their members in various sciences; and it is also true that schools generally are greatly improved by the introduction of studies of a general nature; for many pursuits opportunities are thus afforded of acquiring as large a share of general information as is requisite, but there are other departments of business to which the knowledge thus obtained is not so applicable. The education of the nobility, gentry, and clergy, usually terminates with the studies proscribed for them in the colleges or schools they attend; but with men of business the school and college are to be followed by another kind of education, to fit them for the respective professions or business for which they are destined. In the usual routine of commercial and manufacturing establishments, the experience of a few years, accompanied with ordinary application, is all that is requisite. In the medical profession a still further course of study is required, and it is only by passing a rigid examination that the medical student is authorised to practise. In following the profession of an engineer, and especially that of a mining engineer, the proficiency of the student is not subjected to any test, and his eventual success is, in most instances, the only criterion of merit. In this and in every profession it will be found that success, generally speaking, is the lot of all who diligently pursue their avocations; and, so long as we live in a land of freedom, it would, perhaps, be impolitic to place any restrictions on the exercise of professional duties other than as the common interest of society demands, as is the case in medical and surgical education. We shall now proceed to show in what manner we conceive that a public establishment might be advantageously formed for the advancement of persons intended for the professions to which we have more particularly alluded.

The duties of civil and mining engineers are of great importance to the community. Independent of the immense capital frequently placed under their direction, the lives and safety of the public often depend on the skill and security of their works. In mines this is particularly the case, and the numerous accidents which from time to time occur in mines, is a strong reason for the advocacy of every improvement that can be readily obtained. When a student has gone through a good course of education at school, followed by a clerkship in the office of an engineer, the universities are now the only places in which he can seek for any further accessions of knowledge. The expense, the peculiar forms, and the inadequacy of the instruction for practical purposes, at these institutions, are such as to preclude many young men from any attempt to avail themselves of the privileges they afford, nor is there any other establishment at present existing in which the student of these professions can improve himself by a regular course of study. Such an establishment, we conceive, ought to be formed in London, founded on the principle and conducted in the manner of the Royal College of Surgeons. The objects of this establishment would be as follows:—To institute a regular course of studies in chemistry, mineralogy, and geology, in particular, and in mechanics, hydrostatics, and other departments of physical science generally, with especial reference to the works undertaken by engineers, and to the duties to be performed by the conductors of mines. Geometry and the drawing of plans and sections would form an especial object of such an establishment, and, by its instrumentality, many important advantages might be conferred on the mining interests. As branches of such a college, establishments ought to be formed in the principal mining districts throughout the kingdom, where, under a general system, founded on and supported by the parent institution, the humble classes of mine agents might obtain such knowledge as would be useful to them in their several departments. As regards miners—*the mine* itself is the great school in which most is to be learnt; but, in addition to the matter-of-fact details to be learnt underground, there can be little doubt that much solid advantage would flow from a more general diffusion of scientific knowledge among the practical managers of mines.

An intimate acquaintance with scientific details, opportunities of studying mineralogy, with access to the collections in the British Museum and Geological Society—attendance on regular courses of lectures, and the pursuance of a methodical train of studies under the discipline of a collegiate institution, together with the stimulus of acquiring some distinctive marks of proficiency, would, we doubt not, tend materially to advance civil and mining engineering. From the influential members of the Geological Society, and of the Institution of Civil Engineers, very able and efficient aid might be probably obtained in the formation of such an institution, and in recommending it to the notice of government. The subject is one which has for some time past received much attention from those who are interested in the progress of mining and engineering; and the important feature which railway projects now form in the commercial statistics of this kingdom, is a convincing proof of the necessity of cultivating, as much as possible, those useful and practical details which can only be afforded by an institution expressly adapted to these objects. Such an institution, we trust, will ere long be actively promoted; and, if once established, we firmly believe that it would tend to increase the talent and respectability of the profession of engineering—would add value to public undertakings, by the skill bestowed on their construction—that it would disseminate that *eminence* in reputation which is now engrossed by a few individuals, who are overloaded with work—in short, that it would give character and stability to a department of knowledge, which, as compared with classical learning, has been greatly underrated and neglected, but which is, nevertheless, of the greatest importance to the best and most permanent interests of this country and of mankind.—*Mining Review.*

New Lamp.—A lamp of a new construction, which describes a circle of light of about thirty feet in diameter, of the apparent intensity of sunshine, showing the objects within its sphere as distinctly as on the table of a camera obscura, has been erected at the head of the inclined plane in St. Leonard's depôt. Its object is to enable the engine-man to a distinct view of the inclined ropes during the night, and this has been fully attained. The lamp consists of an Argand burner, placed in the focus of a large speculum, of a peculiar form, by which the whole line is distributed just on the space where it is required. It is computed that the light on the above space is equal to that of twenty-five or thirty similar burners in common lamps. A lamp of this kind we have no doubt would be useful for other purposes. It appears to us that the largest assembly-room might be brilliantly lighted by one placed at each end of the room, and one would be sufficient to light the stage of a theatre. The cost of this one is said to be about 200*l.*, but we understand it saves an annual expense of about half that sum. The inventor is a Mr. Rankin, and he names it the conoidal lamp, probably because the light is thrown from it in the form of a cone.—*Caledonian Mercury.*

Geology.—Geology, or the study of the earth, may be said to be altogether modern as a science; until towards the end of the last century, it was little understood; perhaps because those sciences on which it greatly depends, chemistry and mineralogy, had not made any large advances towards their present state. It is no marvel therefore that, in default of a knowledge of the sciences, and of that research by which alone we can become acquainted with the constituent masses of the globe, the activity of the human mind should attempt to account for the creation and present state of the earth by uninstructed efforts of the imagination

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